

# FIRE II Cirrus

## Mission Summary



Date: November 21, 1991

Julian Day: 325

Experiment Day: 9

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Mission Scientist: David Starr  
Deputy Mission Scientist: none

Mission Objective:

Regional development and dissipation of cirrus systems and observation of cloud microphysical, radiative and dynamical properties.

Mission Description:

Day #1 of First Intensive Observing Period.

- **Large-scale:** Activation of the large scale rawinsonde network (6-hourly observations) will provide a very good test data base for regional models as widespread cirrus were observed over the western United States with some notable dissipation regions.
- **Daytime Operations:** This day was "Frustrating Thursday" as the cirrus cloud dissipated over western Kansas throughout the day and extensive cirrus developed over Nebraska during the afternoon. Although not planned as such, a clear sky mission midday was flown by the ER-2 over the Hub. Some observations of an extensive altostratus layer to our north were obtained. Unfortunately, the HIS data system failed which significantly diminished the value of this mission as a clear sky spectral radiation mission. Surface-based systems worked well, especially the spectrometers. A Sabreliner mission was also flown in an attempt to sample the dissipating cirrus over central Kansas. Good clear sky radiation data were obtained.
- **Nighttime Operations:** A first ever nighttime mission was flown by the Citation to perform in situ microphysical sampling of cirrus clouds in coordination with extensive ground-based lidar, radar, and passive radiometric observations at the Hub. These observations should prove quite interesting as the subject cirrus clouds provided beautiful optical displays under a full moon. Mechanical problems prevented participation of the King Air. Unfortunately, cirrus were only present over the Hub early in the mission and middle level clouds developed later. However, excellent in situ observations were also made of a dense cirrus band just to our west.

Weather Synopsis:

Clear skies prevailed over southeast Kansas throughout the day. Early morning temperature dipped below freezing with a heavy frost under calm conditions. By noon, clouds were visible on the northwest horizon. Southerly winds increased to 15 knots during the day and temperatures reached 60deg.F by early afternoon. By late afternoon, cirrus clouds started drifting overhead. Generating cells were noticed in contrails with numerous fall streaks as the cells dissipated. By sunset, more concentrated patches and bands drifted overhead from the west. Rawinsonde and Raman lidar observations indicated moist regions at heights of about 4 and 8 km. Radars and lidars indicated cirrus clouds in the 8 to 11 km height range. Marvelous optical effects were observed during the early evening in association with the cirrus clouds and a nearly full moon including "moon dogs" with lateral streamers, a 46deg. halo and an upper tangent arc. A middle level cloud deck formed in the late evening. Surface winds declined and temperatures dropped to near 50deg.F during the evening.

Synoptic Situation:

Zonal flow in the west brought a steady stream of middle and upper layer clouds to northern California, Nevada, Utah, and Colorado throughout the day. The clouds dissipated over central Kansas throughout most of the day, but finally reached eastern Kansas by sunset. The FSL/MAPS isentropic analysis indicated that the persistent subsidence zone in central and eastern Kansas was associated with a wind direction change from westerly to northwesterly and a dramatic "downhill slide" to the Gulf Coast where an intense dry band was very evident on the VAS water vapor channel imagery. Winds in the upper troposphere increased to greater than 50 knots and became westerly by the time cirrus were observed over the Hub. A low cloud deck advanced into the area from the north and west during the evening.

Aircraft	Depart	Land	Notes
NASA ER-2	11:05 CST	16:25 CST	Arrival over hub @ 12:32 CST, Clear skies, HIS failed
NCAR King Air			Flight canceled, mechanical problem
NCAR Sabreliner	12:57 CST	14:53 CST	Only a few thin clouds observed, no cloud physics data, cryogenic hygrometer failed
UND Citation	18:50 CST	22:27 CST	Excellent evening flight over Hub

Satellite	Hub Overpass Time	Zenith Angle	Azimuth Angle	RAOB
NOAA-11	20:28:36	34.70	71.75	yes
	10:33:30	55.80	291.44	no
NOAA-12	15:05:30	54.33	290.59	yes
	00:45:42	54.24	68.91	yes

Rawinsonde Operations:

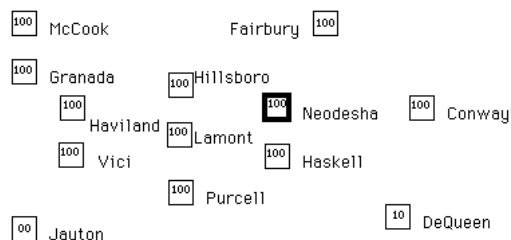
- Inner NWS stations (Type A): Intensive mode @ 12, 18, 00, and 06 UTC
- Outer NWS stations (Type B): Intensive mode @ 12, 18, 00, 06 and 09 UTC
- Hub CLASS station: Intensive mode @ 12, 18, 00, 06 and 09 UTC,
  - plus satellite overpasses @ 15, 21, 01 UTC
- Remote CLASS stations: Intensive mode @ 12, 18, 00, 06 and 09 UTC
- Hub GSFC/WFF station: Launches @ 18, 22, 23, 02, 05 UTC
- CSU Parsons station: Launches @ 16, 18, 21, 23, 01, and 02 UTC



#### FIRE Profiler Status:

- CSU 405 MHz @ Parsons: Continuous operation (RASS during afternoon)
- PSU 50 MHz @ Coffeyville: Testing
- NOAA 405 MHz @ Coffeyville: Not operational

#### NWS Wind Profiler Status:



#### SPECTRE Operations:

Fairly intensive afternoon and evening operations. All spectrometers participated in the afternoon observations while two of the spectrometers and the Raman lidar made observations in coordinations with the evening FIRE operations. Numerous soundings and other ancillary observations were made. This should be a good SPECTRE case of clear sky and thin cirrus at night. Raman lidar crew experimented with using the nighttime wavelengths for daytime observations but were only able to detect returns to 1 km.

#### Aircrew/Mission Scientist Debrief Notes:

- ER-2: N-S legs over Hub to Topeka. Good observations of clear sky radiances over the Hub and a dense altostratus cloud system over Topeka. HIS data system failed and data lost.
- SABRELINER: Good observations of clear sky radiances over central Kansas. Extensive cirrus seen farther to the west during mission but out of range for sampling.
- UND CITATION: Initially sampled cirrus clouds with bases at about 8 km over the Hub in agreement with LaRC and U.Wisc. VIL lidar and NOAA radar observations which indicated cloud top at from just above 9 km to just below 10 km depending on the system. Legs were done at 31 (a few wisps at top), 30, 29, 28 and 27 K' with the last pretty much under the cloud that was becoming very thin and wispy. Did observe 200 um particles at 26 K'. Then moved 40 miles to the northwest to sample a much denser cirrus band observed by GOES - "GOOD CIRRUS AT LAST" was the comment by the airborne science observer. Flew on 250deg./70deg. heading at 33 and 35 K' with ramp up/down in the band and a spiral descent from 31K' Raman and LaRC observed cirrus from 8 to about 10 km at this time while VIL had some returns from near 11 km and CO2 observed a thin band at 10.5 km to the NW. Small ice crystals predominated at cloud top (~50 um) while crystals up to mm size were observed near cloud base where some light turbulence was found.

#### Significant Hardware Problems:

- Sabreliner cryogenic hygrometer failed - no data.
- King Air mechanical failure - no flight.
- ER-2 HIS failed.
- NOAA 405 MHz profiler not operational.
- PSU/NOAA 50 MHz wind profiler/RASS still having noise problems -
  - presently testing a fix, data may be recoverable Hub CLASS RAOB problems during 1800 UTC flight.
- U.Wisc HSR lidar operating as dual-polarization lidar.

#### Highlights of FIRE Operations:

- Collected enhanced temporal resolution rawinsonde data set over central and western United States that will provide a very good test case for regional models as widespread cirrus were observed over the western United States with some notable dissipation regions.
- Excellent clear sky spectral radiation measurements (midday).
- First ever nighttime in situ observations of cirrus clouds coordinated with extensive ground-based remote sensing observations.
- First case of nearly full-up lidar observations: U. Wisc. HSR lidar is now operational as a dual-polarization lidar, U. Utah system is now operational as single-channel dual-polarization system, and the LaRC, U.Wisc VIL and NOAA CO2 systems continue to perform well
- Great observations of thin cirrus producing strong optical phenomena at night.

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## Instrument Logs

### Active Sensors

Active Sensor	UTC Hour																								Notes
	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	
Utah Lidar H											X	X	X	X	X	X	X	X	X	X					
LaRC Laser Ceilometer H	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Wisc HSR Lidar H														X	X	X	X	X	X	X					POLARIZATION ONLY
Wisc Vol Image Lidar					X								X	X	X	X	X	X	X	X					
GSFC RAMAN Lidar H													X	X	X	X	X	X	X	X	X	X	X	X	
NOAA CO2 Lidar H		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
NOAA Radar H		X	X	X	X							X	X	X	X	X	X	X	X	X	X	X	X	X	





